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ABSTRACT

The document contains the texts of three presentations from a conference on financial support of the sciences and humanities in West Germany and the United States. The first paper explains financial support of the sciences and the humanities in West Germany. Awards and uses of funds are primarily determined by the scholarly community, which also receives most of the funds. Humanities receives only about 17% of the total expenditure, but it has an important role in the educational system. Humanities in West Germany includes Roman law, philosophy, economics, philology, and linguistics. Scientific research is carried out by universities, government-sponsored institutes, and industry. The second paper explores the rationale and structure of support for the humanities in the United States. Humanities in the United States includes history, literature, philosophy, religion, and ancient and modern languages. Support comes from universities, libraries, museums, learned societies, and the publishing industry. Private foundations recently have not given consistently strong support for the humanities. Federal and industrial support of the sciences in the United States are reviewed in the third paper. Basic research, applied research, and development have been strongly supported since the 1950s to increase national defense, and in private industry, to create future profits. The Congressional debate system over science policy issues is described in detail. (AV)

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THE SUPPORT OF THE SCIENCES AND HUMANITIES IN WEST GERMANY AND THE UNITED STATES

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Dr. Albrecht Holschuh, Germanic Languages, Indiana University, served as editor.

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Inquiries regarding project publications should be addressed to the Institute of German Studies.

Eberhard Reichmann
Project Director and Editor-in-Chief

THE SUPPORT OF THE SCIENCES AND HUMANITIES IN THE FEDERAL REPUBLIC OF GERMANY

Heinrich Pfeiffer

Introduction

The initiator of this conference must know the Federal Republic of Germany (referred to later on as Germany) very well, for he invited only one speaker to report on the support of the sciences and humanities in our country. Obviously he knew that had he invited two speakers he would have two completely different reports, and the conference participants would have been left with the impression that they had heard talks of two quite different nations and topics.

Of course, if two speakers expounded their views on one country's system of support, this would have the advantage of leaving to the audience the choice of what it should accept as the truth, whereas in the case of a single speaker the motto is: love me or leave me.

I. Reasons for Public and Private Support

Why does Germany sponsor the sciences and humanities? And why should it sponsor chiefly research in these fields? Would it not - from an economic point of view - be more sensible and more reasonable to buy technologies from other countries, instead of developing them at home and accepting all the risks that such developments entail?

Compared with the United States of America, Germany is a small country. 62 million inhabitants conglomerate on only 95,000 square miles. The equivalent figures for the United States are 215 million inhabitants for 3.7 million square miles.

The economy of Germany is extremely dependent upon export. In 1974, 23.1% of the gross national product was acquired from export. In the United States it was only 7.1%. While Germany has a small home market, the home market of the United States is actually capable of developing to nearly unlimited extent. Germany has only limited raw material and energy resources. It is dependent on imports, and its high standard of living can only be maintained if, within the international division of labor, it exploits its actual economic and scientific potential: the qualification of its scientists, technicians and skilled workers, the highly developed technical and economic infrastructure, and the country's advanced position in technology. To maintain this, continuing intensive efforts are necessary. This does not mean, though, that we should try to carry out our research in national isolation.

II. The Present State of Higher Education

In Germany there are no private universities. There are 63 wissenschaftliche Hochschulen (institutions of higher learning) where a "German Ph.D." can be obtained. Except for two Federal Army Colleges, one in Hamburg and one in Munich, they all are financed to almost 90% by the eleven States (Länder). Only the churches maintain theological academies of their own, where theologians can do part of their studies.

In the 1960s Germany "set out on the road to a new world." Students, university teachers, scholars, parents, politicians, all felt that, at last, more had to be done for education and science. Everyone who wanted to stay on the ball and keep up with the current discussion tried to draft a "grand design" of the future. Year after year plans were published describing the ideal of education and science of the future. They were carefully planned steps on the way to a "brave new world."

The consequences were soon evident: never before had there been such an increase in the number of students, in the appointment of university teachers and in the allocation of

funds for education and research, with annual rates of increase of up to 25%.

During the years between 1965 and 1975 the number of students in Germany more than doubled (see tables 1 and 2). Whereas twelve years ago 13.3% in the 19-21 year age bracket were starting university training, the figure for 1975 was 19.7%. But in comparison to the current figure for the United States (where it is more than 40%), it is still a small percentage.

The number of positions at universities and other institutes of higher learning increased almost as rapidly. Teaching staff in Germany figures 80,000 against 360,000 in the United States (see tables 3 and 4). In 1975 the Federal Government and the Länder governments, the local communities, and industry together allocated approximately 33 billion dollars towards education and research (see table 5). This was 8.4% of the gross national product. It was four times the amount of 1965. The largest amount, almost 50%, was provided by the eleven states (Länder).

Multiplied problems

These remarkable figures and enormous efforts, however, do not mean that after the period of the "economic miracle" (Wirtschaftswunder) Germany has turned into a "wonderland of sciences and humanities." The multiplied number of students has brought with it multiplied problems. The expansion of the universities and institutes of higher learning could not keep pace with the number of students. As a consequence, for more and more subjects a limitation of admission, the so-called "Numerus clausus," had to be introduced, so that for certain subjects not all applicants could be admitted. Politicians and court decisions call for "open" universities. The growing cost of expenditures in the fields of education and science were not matched by the necessary personnel and equipment in scientific institutions.

Most of the annual growth of costs has repeatedly been eaten up by linear and structural salary increases. Today the universities spend more than two-thirds of their budgets on staff and administration, and scarcely one-third can be used for research purposes. If it were not for the funds from the German Research Society (DFG) and other sources, the situation would be even worse.

This development has had a deep impact on university studies. Between 1967 and 1973 total public expenditures per student increased by up to 130%, the highest increase being in medical studies (from ₰ 54,000 to ₰ 125,000; see table 6). One third of this increase was due to the prolongation of the course of studies. Despite all efforts to shorten the curriculum, the average duration, as compared to ten years ago, has increased by approximately 30%, from five years to six and a half. Here we hold an uncomfortable world record jointly with the Netherlands. Sometimes one had the impression that no support was necessary for the "production" of students. A certain automization seems to have developed. According to latest statistics, there seems to be a decreasing desire on the part of high school graduates to enter the university.

As a further consequence, the labor market in Germany has not been able to keep up with the rapid expansion of the university population. Thus it has become more and more difficult for graduates to find a job. So far, the biggest employer has been the civil service of the Federal agencies, the Länder administrations, and the local communities. From 1970 to 1975 roughly two-thirds of all graduates found employment in the civil service. Today the rate is much lower, and there are forecasts that in the eighties it may decrease to 15%.

III. The Recent Development of the Sciences and Humanities

The above data might, at first sight, seem to have little to do with the subject. They provide, however, the necessary setting for the discussion of the support of the sciences

and humanities in Germany.

From the very beginning there has been strong competition between the traditional humanities and the relatively young sciences. It was only in 1910/11 that a protestant theologian, Adolf von Harnack, convinced Emperor Wilhelm II that the sciences required research institutes of their own and outside the universities. This lead to the foundation of the "Kaiser-Wilhelm-Gesellschaft," the predecessor of the present Max Planck Society.

The patron of the foundation which I represent, Alexander von Humboldt, is regarded as one of the first scientists in Germany who approached the sciences systematically. In his time he already tried to commit the state to support and sponsor objective scientific search for truths. His brother Wilhelm von Humboldt, on the other hand, was the first German to seek general and public support of education in the classic humanities sense. He was also the founder of Berlin University (1810). Even today we still draw on the heritage of these two very different brothers, and no one can decide whether it should be regarded as a blessing or a curse that Wilhelm von Humboldt had his ideas of the humanities accepted in Prussia and in Germany: the German scholar in his small study, speculating with pencil and paper, revealing the ancient philosophies - a product of the traditional German humanistic school.

I would formulate my own thesis after the physicist and philosopher Carl Friedrich von Weizsäcker. Nature existed before there was a human being, man existed before there were the sciences. Man has created this environment, an environment which we call culture Contemplating on nature is, therefore, one of our culture's basic requirements. In this light the antithesis of science-culture-humanities is more than doubtful. Weizsäcker is a contemporary example. I could have quoted Rutherford, Einstein, or Heisenberg, who were outstanding scientists in the theory of physics. In their later years they became philosophers and developed epistemological maxims in the philosophy of theoretical physics, thus demonstrating that there is only one intellectual world, including the humanities, the arts, and the sciences.

An Important Role

The humanities require for their activities only about 1% of the total expenditure in science and research. However, they play an important role at the universities and in the educational system. I have in mind not only Roman law, philosophy, or sociology, but also economics and, above all, philology and linguistics. As inhabitants of a small country within the larger economic area of Europe where fifteen languages are spoken, Germans simply have to learn foreign languages. We are compelled to learn two or more languages, not just to understand our neighbors and to trade with them, but also to comprehend their intellectual and cultural achievements and, in return, to profit from them for the enrichment of our own culture.

This last point mentioned is certainly the reason for the high standards of the so-called "orchid subjects" of the humanities in Germany. It was a German, August Wilhelm Schlegel, who established indology as a subject. In hardly any other country are Byzantine studies, Greek studies, Latin studies and Mongolian studies as well established as in Germany.

I am rather hesitant when it comes to archaeology. Actually we have not gone beyond the geographic farsightedness of Heinrich Schliemann. We are still busy searching for new archeological finds in the Mediterranean regions (Greece, Turkey, Egypt, Iran, Persepolis). I mention this as a criticism. I, personally, would like to see not only English and French archaeologists but also more American and German archaeologists work on revealing the history and culture of South America, for example.

The Humanities in the Humboldt Program

My judgment as a servant to the sciences and humanities is based on the experiences which the Alexander von Humboldt Foundation has made in promoting international scientific exchange by awarding research fellowships to foreign postgraduates who want to pursue their research in Germany. Since 1953 when it was re-established after World War II, the Alexander von Humboldt Foundation has sponsored approximately 6,000 foreign scholars (among them assistant professors, associate professors and full professors) from 78 nations.

We found out that during the first 15 years following the re-establishment the proportion of Humboldt fellows of the humanities remained relatively constant at 40%. In 1966 it reached almost 50%, the highest rate ever. Among them were a large number of scholars of the legal profession from countries where the legal system traditionally had been connected with the German system (e.g., Greece, Turkey, Spain, Korea and Japan), and historians from the United States and from Great Britain doing research on subjects like militarism and national socialism (Nazism, Hitlerism). In the mid-sixties a sudden change occurred. The proportion of research fellows of the humanities decreased rapidly to about 28% where it leveled off.

As a consequence the sciences' share went up to 72%. Statistics of the Humboldt Foundation show that for several years the physicists formed the largest group. Later, in the seventies, it was the chemists, in particular representatives of the field of organic chemistry and the life sciences.

The Standard of the Sciences

What is today's standard of the sciences in Germany? I must confess that I would prefer to discuss why there were such outstanding scientific achievements in Germany in the "Golden Twenties." Undoubtedly, at that time Göttingen was the place where mathematics and physics had reached the highest standard in the world. The reasons for the change occurring some years later are known and belong to the most deplorable and saddest era in the history of the German nation.

After World War II it was not until the sixties that the standard of the sciences went up again. There are two explanations for this. First, until 1955 German scientists were not permitted to work in fields of atomic energy or radio isotopes, etc. Secondly, a new generation of scientists had to be trained, their predecessors having been decimated by the war and by the brain drain to other countries during the early reconstruction period. Fortunately, Germany received some help. There is hardly one reputable scientist who after World War II did not spend a certain time working in the United States in order to catch up with the international standard of the sciences.

The reason why the USA and the USSR allocate enormous public funds not only for atomic and space reseach but also for scientific research in general lies, undoubtedly, in the importance these fields hold for defense. It would be hard to believe that parliaments and governments would have made such financial sacrifices had they not feared a weakening of their defense systems and the actual or supposed consequences of such a decline.

For some time it seemed that Germany could do without providing large public means for the sciences. This proved to be wrong for a small country with high economic capacities. Public contracts did not only bring about the products that were required for defensive measures, but entailed also modern technological appliances and instruments, and resulted in a continually increasing industrial productivity. New materials were produced and tested, new precision instruments and appliances invented, and new methods developed. Indirectly this process led also to the technical improvement of a large number of consumer goods and to improvements in large scale production.

Considerable Growth Rates

Thus, the small Federal Republic of Germany - just as France, Great Britain and Japan - was faced with the unpleasant alternative of either spending large public funds for modern technological development or of leaving this field to other nations and their industrial branches. In the 1960s Germany decided to allocate more funds for the sciences. The smaller the "element" to be studied, the more effort is needed; and the most sensitive precision instruments have to be developed in order to explore the smallest particles in physics or in the life sciences.

During the past twenty years the decentralized federal structure of our country has proven to be advantageous, but difficult at the same time. When State (Land) A decided to set up a center for nuclear energy (in Jülich) it did not take long for State (Land) B to find it should do the same (in Karlsruhe). The competition between A and B led to good results: alternately A and B took the lead. Competition does not only spur business but it also acts as a stimulus for the sciences. In addition, there is the international scientific competition.

The allocation of funds is a problem which has to be solved by every nation. Who is to decide where the large public means for the sciences should be appropriated? Clearly the political responsibility cannot be taken off parliament and politicians, and it is the duty of science to give pertinent and objective advice. For a politician it is difficult to judge a scientific project proposal, the qualifications of the researcher, or the scientific objectives. This is not meant as a reproach. Suffice it to say that politicians and scientists alike have to know their limitations and should be fully aware of them.

In passing, we might mention that in the fields of nuclear technology, radio astronomy, plasma physics, and in the vast domain of chemistry internationally recognized achievements have been made in Germany over the last ten years or so.

The Old Farmers' Saying

The considerable post World War II increase of the portion of the gross national income allocated for research was only possible because the people were aware of the fact that the contemplated research work would result in technical and scientific seed to bear fruit later on. Particularly during a period of economic recession the expenditure for research should be raised, following an old principle of German farmers. They have a saying that out of a bad potato harvest the best potatoes should be preserved for the coming season as seed potatoes, and the potatoes of minor quality should be used for food. In a federal nation, like yours and mine, this farmers' wisdom could serve as a pointer in the negotiations on supporting - not only financing - research.

My view would be: it does not matter so much who does the necessary things; it is more important that they are actually done. It causes concern that our present society, a society which does not live in privation and which assumes a rather nostalgic attitude, would be willing to exert all its energy in the economic field as well as in the field of sciences only if it were absolutely necessary. I belong to the few people who regret that the oil crisis did not last a little longer. In this connection I would modify the saying "Necessity is the mother of invention" to "Necessity is the mother of thinking."

IV. A Network of Research Institutions

There is a network of research institutions in Germany. We can distinguish between three major areas:

1) University research,
2) Government-sponsored research outside the university,
3) Research carried out by industry.

1. University Research

Despite all difficulties and troubles experienced at the German universities, university research still provides the biggest contribution to the development of the humanities and the sciences. About two-thirds of the entire research staff potential and two-thirds of the potential of government-funded research are provided by the universities. University research deals with subjects from all disciplines. More than anywhere else research and studies at the universities should be determined by individual talent, inclination, and willingness to make sacrifices. One should not expect short-term success, especially as far as minor subjects are concerned. This makes it possible to orient oneself towards fundamental research, and allows for interdisciplinary cooperation.

A university teacher should, according to Wilhelm von Humboldt's idea, be teacher and researcher in one. He has the right - as manifested in the German constitution - to decide on the sort of research and on the place and the person with whom he wants to do this research. Actually this is hardly practicable because universities receive almost their entire funds from the state. As the state's tasks and duties are so manifold it is inevitable that the sponsor is interested in supporting research in the best possible way and therefore tries to set sensible priorities. In this context it must also be mentioned that out of 100 university teachers only 30, at most, do primarily research. This is not meant with a negative bias to the remaining 70% who concentrate more on passing on knowledge, while the 30% search for new knowledge. It is still true today that most of the new scientific findings stem from the universities, though the phenomenon of mass education makes this task more and more difficult.

2. Government-Sponsored Research outside the Universities

Government-sponsored research work outside the universities can be divided into five areas:
(a) The Max Planck Society,
(b) The Großforschungseinrichtungen (big research institutes),
(c) The Fraunhofer Society,
(d) The Academies of Science,
(e) Governmental and semi-governmental research institutes.

(a) The Max Planck Society

The largest research-promoting organization in Germany, the Kaiser-Wilhelm-Gesellschaft (Emperor Wilhelm Society) was founded in 1911 and re-established in 1948 under the name of the Max Planck Society. It operates 51 institutes employing more than 10,000 persons, among them 4,000 scientists. It concentrates on fundamental research in the sciences and humanities, with emphasis on new research fields which, due to their objectives, size and structure, are not yet mature enough or not appropriate for university institutes. The Max Planck Society tries to go to new ways and apply new methods. It endavors to blaze new trails for research and helps to supplement other research institutions. Its focus lies in the field of life sciences, in the vast sector of physics (theoretical physics, elementary particles, extra-terrestrial physics, radio astronomy, solid state physics, etc.) as well as in some fields of the humanities. 90% of its financial resources are provided by the Federal Government and the Länder governments, 10% from membership contributions and from foundations, requests, and patents. The 1975 budget amounted to 290 million dollars. One-third of this amount was

appropriated in the field of life sciences (including behavioral science and molecular biology), close to one-third was spent for fundamental research in physics and chemistry. 7% was allocated for the humanities. The 7% nonetheless financed 9 out of 51 institutes (comparative, international, private, criminal, and public law; history of law; problems of the industrial society). Especially the Humanities Section of the Max Planck Society has been considerably extended in the last few years. The latest project in this field is the setting up of an Institute of Social Sciences with headquarters in the Netherlands.

(b) The Großforschungseinrichtungen (big science institutes)

The second field of government-sponsored research institutions outside the universities is generally described in Germany by way of the English term "big research institutes (Großforschungseinrichtungen). These research installations were developed after the war aiming at facilitating large-scale research and safeguarding large-scale projects. A few examples are the nuclear fast breeder project in Karlsruhe, the high temperature reactor development, and projects on controlled nuclear fusion in Garching and Jülich, the satellite project of the solar probe "Helios," high energy physics, plasma physics, the Central Cancer Research Institute in Heidelberg, the facilities for air and space technology of the DFVLR in Cologne, the German Electron Synchroton (DESY) in Hamburg, and the heavy ion accelerator in Darmstadt. At the moment there are 12 such "big research institutes." They receive a total subsidy of approximately 630 million dollars per year, 90% of which is allocated by the Federal Government and the remainder by the Länder governments. At present 16,000 persons are working at these institutes, including 4,000 scientists.

(c) The Fraunhofer Society

The Fraunhofer Society deserves special mention. It supports 30 institutes of applied research with an expenditure of nearly 25 million dollars per year (1974 figure). The main interest of one-third of these institutes is directed towards problems of defense research. The other two-thirds work - by way of contract research - in the field of applied research for private and public clients.

(d) The Academies of Science

For historical reasons I should have mentioned the five academies of science in the second place. Their tradition in Germany dates back more than two hundred years. But their scientific importance is no longer that great. They only support the humanities on long term projects, in particular projects reaching beyond a scholar's lifetime, as for instance the editing and publication of complete works, dictionaries, glossaries, etc. For example, the editing of Hegel's complete works has been under way for more than one-hundred and fifty years. It took Hegel himself only thirty-two years to write them. As to the Thesaurus Linguae Graecae, Meyer's Encyclopedia wrote in 1907: "The work is progressing extremely well and will be completed within twelve years." Since then, seventy years have passed, and at present they are up to the letter "Theat," The five academies, located in Göttingen, Munich, Heidelberg, Mainz, and Düsseldorf, require approximately 9 million dollars per year.

(e) Governmental and Semi-Governmental Research Institutes

The last category to be listed are the research and semi-research institutes, approximately 300 by number, which are financed by the state. About half of them are institutes of the Federal or the state governments and the local communities. The other half of this group can hardly be integrated into any system. They are more or less small research units, employing five to ten scientists.

3. Research in Industry

The research institutes in industry are, for obvious reasons, primarily oriented toward practical application and to a lesser degree toward pure research. Their expenditures amounted to about 4.5 billion dollars in 1975. Almost all research in industry is carried out within the individual enterprise, and only a small part as group research, financed and staffed by groups of firms in joint research institutes, or as "contract research." The leading partners are innovation-interested and export-oriented growth sectors such as chemistry, machine-building, or electrical engineering. An especially successful research tradition can be observed in the chemical industry.

V. Research Sponsors

Such a manifold and highly ramified network of research institutions requires instruments of steering, planning, and cooperation in order to secure optimal use of funds, to shift the research activities to appropriate investigations, and to help solve structural, organizational, and financial problems. How should it be done? I should like to demonstrate this by the example of two tales from ancient times: 1. Thales of Milet is said to have calculated a solar eclipse by virtue of exact astronomic observations he had carried on for many years without electronic devices. This solar eclipse occurred in 585 B.C. during Thales' lifetime. 2. The same Thales of Milet is also said to have fallen into a well while observing the stars in the sky, and to have drowned.

We can conclude from these science history tales that predictions and plans are possible and useful. They should not, however, be directed towards a too distant future because otherwise more urgent and imminent tasks of today are neglected. Those who only plan for the future can easily lose a sure eye for the present and risk falling flat on their faces, a fact which forever has to be made clear to policy makers in Germany, or as Schopenhauer put it, "the Germans are always seeking in the clouds what lies at their feet."

1. The German Research Society

The most important body for sponsoring and coordinating research is the German Research Society (Deutsche Forschungsgemeinschaft). It was founded in 1920 as the Notgemeinschaft der deutschen Wissenschaft (Emergency Association of German Science) and resumed its activities after World War II. Membership is granted not to single individuals but solely to institutions and organizations. The main members are universities, academies, societies and other scientific institutions such as the Max Planck Society and the Fraunhofer Society. The German Research Society promotes German science including the humanities in all fields by providing financial support to German scientists for research projects, and by promoting cooperation among German scientists. It also advises parliaments and ministries in scientific matters and helps to keep German research in contact with German industry and science abroad. It encourages especially the promotion of junior scientists.

The 1975 budget amounted to 250 million dollars. More than half of this amount was provided by the Federal government. The research targets are determined by its Senate which is composed of 33 members from the scientific community. In 1975 the DFG supported almost 19,000 scientists or fellows working on research projects. The 1975 allocations were distributed among the scientific disciplines as follows:

The humanities (incl. social sciences)	35.4 mill $ =	17%
Life sciences	72.7 mill $ =	28%
Other natural sciences	48.1 mill $ =	23%
Engineering sciences	44.5 mill $ =	21%
Environmental sciences	4.2 mill $ =	2%

The remaining 9% were allocated to various sponsorships (i.e. libraries, computing centers, establishing contacts abroad, etc.).

Approximately one-third of the allocated amounts for grants go into the promotion of the Special Research Areas. In 1976 there were 116 such Special Research Areas. They serve mainly interdisciplinary cooperation, cross-institutional and cross-faculty cooperation, and in general the cooperation of various research institutions. They provide for the concentration of personnel and scientific equipment by means of planning and cooperation. Since 1969 approximately 500 million dollars has been spent in these areas.

2. The Federal Government

An important part of the financial support for the science and humanities is provided by the Federal Government. Together with the Länder governments it established, in 1957, the Wissenschaftsrat (Science Council) as the central advisory and coordinating body for science policy in Germany. In this body representatives of the Federal Government and the eleven States (Länder) work closely together with distinguished scientists and economists, union leaders, and others.

Initially the Federal Government only reluctantly supported research and development. Today this is no longer the case. Two ministries, the Ministry for Education and the Ministry for Research and Technology, work with a budget of approximately one-and-a-half billion dollars each. In cooperation with German industry the Federal Ministry for Research and Technology supports four main program areas:

1. New technologies (including oceanography),
2. Data processing,
3. Nuclear research and development of nuclear engineering,
4. Space research, technology, and aeronautic research.

The Federal Ministry for Education (Wissenschaft und Bildung) for its part provides the funds for university research through the German Research Society (DFG) and, e.g., for the construction of university clinics and for the student scholarship program.

3. The Major Foundations

An indispensible instrument for the coordination and promotion of science is provided by the foundations as non-governmental agencies. If I were to digress about foundations promoting the sciences and humanities in the United States, it would mean "carrying coals to Newcastle" or "salt to Salt Lake City." Unfortunately we cannot compete with America in this respect. In 1976 the five leading private German foundations (Volkswagen Foundation, Donors' Association for the Promotion of Science, Krupp Foundation, Bosch Foundation and Thyssen Foundation) raised about 75 million dollars. The foundations in Germany are ranked highly with regard to the promotion of science, because, unlike the research administration at the universities and other research institutions, they remain extremely flexible. Their activities supplement other programs, and they are able to initiate important new developments in the field of research policy, although the respective allocations are very often minimal. They can devote themselves to topics and subjects which, for various reasons, are not sufficiently emphasized elsewhere. The income of these foundations normally accrues from gains derived from the foundations' capital. An exception to this rule is the Donors' Association for the Promotion of Science which obtains its resources mainly from endowments or contributions from its 5,500 members (mainly industrial enterprises and trade organizations).

The Alexander von Humboldt Foundation, like the German Academic Exchange Service, devotes its activities to international scientific exchange. The humanities and sciences in Germany naturally also benefit from these activities.

VI. International Cooperation

Many projects can no longer be financed by one single country. They call for international cooperation. This is why Germany participates in numerous international research institutions. Examples are:

1. the European Organization for Nuclear Research (CERN), in which twelve countries are working together (main field: high energy physics);
2. the European Laboratory for Molecular Biology which was established by ten European countries on the initiative of the European Molecular Biology Organization (main field: macro-molecular structures, cell biology, and instrumentation);
3. the Max von Laue - Paul Langevin Institute in Grenoble, a British-French-German cooperation operating Europe's largest neutron beam research reactor (the Director of this institute is Rudolf Mössbauer);
4. the joint research center of the European Atomic Community (EURATOM), which comprises nine member countries (main field: fundamental nuclear research);
5. the European Space Agency (ESA) in which ten European countries participate (projects include satellites, SPACELAB, ARIANE);
6. the development of a uranium enrichment plant (Netherlands, Great Britain and Germany).

Here one should not forget to mention the European Science Foundation which was founded in 1974 by national science organizations as an autonomous, non-governmental, international organization. The European Science Foundation does not run any research institutes, but aims merely at improving European and international cooperation through coordination.

VII. The Outlook

One should not conceal the fact that science as it is today is faced with certain difficulties. The combination of research and teaching at the universities has become almost fictitious. The burdening of the universities, the heavy teaching commitments and the steadily increasing administrative work keep more and more university teachers away from doing research work of their own, and the best scientists are often preoccupied with grant applications. For years now, much discussion has been focusing on the teaching capacity of German universities ("capacitology"), but little mention is made of the research capacity.

During the period of rapid expansion the number of university teachers was significantly increased within a very short period. The new positions were filled by relatively young applicants. Consequently the age structure of the university teachers changed radically. The majority at present is between 35 and 49 years of age, which means that there will be very few replacements during the coming two decades. Especially from 1980 to 1990 the employment prospects, in particular for young researchers, will be extremely gloomy. Highly negative effects are anticipated in the research situation.

As a remedial measure the so-called "Heisenberg Program" has been proposed to provide research fellowships, temporary contracts, and research positions for young scholars who are qualified as university teachers, or "Heisenberg professorships" on a contract basis for more highly qualified young scientists. Others proposed a so-called "rolling quality reserve," a mobile reserve of university teachers with temporary contracts. The discussion on this issue is still continuing.

The overall picture is getting even more critical. Due to international economic difficulties, the growing North-South-conflict, unemployment, and low economic growth rates, public budget restrictions affect all areas including the sciences. On the university level this translates into a tendency to cover the costs for personnel and administration by cutting down on research budgets.

In addition, there is a crisis in the conception of science itself. In the humanities and sciences, an esoteric language, a highly specialized scientific professional jargon, has brought about alienation between scholar and layman. This jargon makes it increasingly difficult to voice the existing problems in such a way as to promote understanding on the part of the individual. Nor do the simplifications by some journalists make it clear enough why the humanities should be supported at all today. One tends to forget that without teachers, lawyers, administrative experts, and economists the standard of technology would soon be lost. The question could also be raised whether a country like Germany (where democracy cannot look back on two-hundred years of tradition as in the United States) could survive without historians.

On the whole research no longer enjoys the high reputation it had before. Jürgen Habermas calls this the "legitimation crisis." Scientists created expectations which they could not fulfill. A direct benefit from research work is no longer taken for granted. The individual citizen has become skeptical and no longer expects miracles from research and development. An overly euphoristic discussion among experts on the use of nuclear energy has spoiled the reputation of modern scientific research. Politicians were dependent upon too powerful a bureaucracy and upon experts' knowledge and information in research matters. They were only moderately interested in research problems, did not recognize the difficulty in time, and thus made it even worse. What this amounts to is that the problems in the support of the sciences and the humanities cannot be regarded from a merely financial point of view. In the last few years this has become clearer than ever before in Germany.

The picture I have given of the support of the sciences and the humanities in the Federal Republic of Germany is manifold, if not confusing. Some may consider it as a proliferation of sponsors, financing bodies and recipients. If one looks at it more closely, however, one sees that not only a large number of organizations and institutions are involved but also a great variety of different commitments which must be met in different ways. The existing variety reduces the danger of wholesale miscalculation, false estimation, or the suppression of individual research work. It provides new openings for research and facilitates flexible approaches to support. Of course, there is always a risk of duplication in research, but coordination and mutual information reciprocity within the organizations and the interlinked systems and other measures have proved their worth in the past. "The remaining risk," as Hans Matthöfer, Federal Minister for Research and Technology, wrote in his recent book on research and technology policies, "is minimal and an acceptable price for the freedom and flexibility resulting from this multiplicity."[1]

[1] Für eine menschliche Zukunft: Sozialdemokratische Forschungs- und Technologiepolitik. Düsseldorf and Wien: Econ Verlag, 1976.

Table 1: Students at German institutions of higher education, 1965 - 1975

Year	Total (in thousands)	of which foreign students (in thousands)
1965	384.4	26.6
1966	406.7	26.6
1967	418.4	26.5
1968	443.6	26.7
1969	473.1	27.3
1970	510,5	28.4
1971	597.8	34.0
1972	661.5	38.6
1973	729.0	42.8
1974	789.8	45.5
1975	840.8	48.7

Source: Federal Ministry of Education

Table 2: Students 1975 (in thousands)

Subject	Number	% of total
Theology, languages, cultural sciences	229.5	27.3
law, economics, social sciences	195.0	23.2
mathematics, natural sciences	142.1	16.9
engineering	160.0	19.0
medicine, veterinary medicine	53.4	6.4
agricultural science	18.6	2.2
fine arts, design	42.1	5.0
	840.8	100.0

Source: Federal Ministry of Education

Table 3: Personnel at German institutions of higher education, 1965-1975 (in thousands)

Year	total		of which at universities (including pedagogical colleges and univ. clinics)			
	scientific personnel	other staff	Professors, "Dozenten"	assistant professors, assistants	other scientific personnel	other staff
1965	38	64	9	18	6	59
1966	40	68	10	19	6	64
1967	41	72	10	20	6	68
1968	44	77	11	21	7	71
1969	48	81	12	22	8	75
1970	54	87	13	25	10	127 *
1971	65	100	15	28	13	145
1972	70	106	17	29	13	152
1973	75	116	18	29	15	167
1974	78	125	19	30	16	180
1975	79	129	24	38	17	184

*From 1970 onwards, staff at university clinics was included

Source: German Science Council

Table 4: Ratio students/scientific personnel 1975

Subject	Ratio
humanities	17.8
sciences	8.8
medicine	2.8
central services (libraries, archives, museums etc.)	229.6

Source: Commission for Educational Planning and Research Promotion of the Federal and Länder Governments

Table 5: Public and private spending for education and research 1970-1975 (in billion $)

	1970	1971	1972	1973	1974	1975
1. Public spending						
preschool education	0.34	0.46	0.57	0.65	0.88	0.76
primary and secondary education	6.38	7.96	8.65	10.03	11.80	12.76
tertiary edication.....	2.65	3.23	3.61	4.11	4.92	5.19
further education	0.23	0.26	0.30	0.34	0.50	0.50
other areas of education	0.57	0.92	1.30	1.23	1.30	1.53
general support of research ...	0.46	0.53	0.61	0.69	0.76	0.80
interim total	10.61	13.34	15.03	17.11	20.23	21.61
"big research" and government research establishements	1.42	1.76	1.96	2.11	2.38	2.69
special program of the Federal Employment Agency	0.34	0.65	0.76	0.80	0.96	1.26
total public spending	12.39	15.77	17.76	19.96	23.50	25.49
2. Private spending						
vocational training, further education	2.65	2.92	2.92	3.25	3.53	3.84
research and development.....	3.03	3.46	3.65	3.80	3.96	4.03
total private spending	5.68	6.38	6.57	7.05	7.49	7.87
3. Total public and private spending	18.07	22.15	24.33	27.01	30.99	33.36
percentage of GNP	6.84	7.57	7.59	7.60	8.11	8.36

Source: Federal Ministry of Education

Table 6: Public expenditure per student and field of studies (in $)

	1967	1973
sciences	50,000	63,000
engineering	25,000	55,000
medicine	54,000	125,000
social sciences	7,000	12,000
humanities	12,000	23,000

THE USES OF THE PAST: THE SUPPORT OF THE HUMANITIES IN THE UNITED STATES

Gordon N. Ray

Since foundations pay little attention to the past, an essay on its uses at our conference should at least have the merit of novelty. The reasons for this neglect are not far to seek. Foundation trustees are usually lawyers or business executives immersed in the problems of practical life. There is no prescribed program of training for foundation officials, and they are cut to no particular pattern, but they too tend to come from the world of affairs, with some leavening of academics who are often social scientists. Consequently foundations are usually managed by people whose aim is to affect the current scene in some immediate, tangible way. They typically justify foundations by describing them as agents of change, which provide the "cutting edge" of society's thrust for improvement and whose grants are the "seed money" that prepares the way for innovation. This philosophy of social engineering hardly makes for retrospective complementation. Instead the prevailing habit of thought regarding the past among foundation officials approaches that achieved by the scientist and aspired to by the social scientist. Alfred North Whitehead once remarked that "before a discipline can become a science, it must first lose its memory," and Sir Peter Medewar has expanded his axiom in the following way:

> A scientist's present thoughts and actions are of necessity shaped by what others have done and thought before him; they are a wavefront of a continuous secular process in which The Past does not have a dignified independent existence of its own. Scientific understanding is the integral of the curve of learning; science therefore in some sense comprehends its history within itself.[1]

There is another habit of thought, however, which not only takes it for granted that we should maintain the past in "a dignified independent existence of its own," but assumes that we have much to gain by constantly exploring the past and indeed by learning after a fashion to live in it. This perspective is the end product of liberal education in its traditional sense; it has its base in the humanities, and its aim is culture. The terms liberal education, humanities, and culture may seem faded and old-fashioned today, but they were once words of power. An English critic wrote more than a hundred years ago:

> When men have not some great pursuit, they abandon culture when they leave school, and (as a distinguished living poet said to me in a letter) 'content themselves with the current enlightenment of the epoch.'[2]

At any rate, this is the opposition that I should like you to keep in mind in considering what follows: does "the current enlightenment of the epoch" suffice for mankind's well-being, or should the past continue to be accorded "a dignified independent existence of its own?"

Since my argument centers on the humanities in their retrospective aspect, I'd better begin by stating what I include in this term. Their cornerstones are history, literature, philosophy, religion, and the ancient, medieval, and modern languages. They are distinct from the arts, yet the organized study of the past products of the arts is a central province of the humanities, and areas like art history and musicology are consequently humanistic disciplines. Moreover, such subjects as geography, anthropology, political

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science, sociology, economics, law, and education can all be viewed from a humanistic perspective, as indeed can science itself. So Oscar Lewis was a humanist as well as an anthropologist, and Carl Sauer was a humanist as well as a geographer, just as Mr. Robert Merton is a humanist as well as a sociologist and Dr. Lewis Thomas is a humanist as well as a scientist. As Sainte-Beuve wrote, "all that is open to general comprehension and interests the human spirit belongs by right to literature." After all this, it should hardly be necessary to stipulate, as it might in another context, that when I use the term humanist, I mean a practitioner of the humanities in line of descent from Erasmus and Sir Thomas More, not a dogmatic atheist.

The humanities are supported in the modern world by a vast system which included not only colleges and universities, but also libraries, museums, and learned societies, as well as a significant segment of the publishing industry --the whole apparatus by which knowledge of the past is achieved, analyzed, set in order, and made available. This apparatus is currently in some disarray. College and university presidents, museum and library directors, officers of learned societies, and scholarly publishers are all sending up distress signals. That they need assistance is undeniable, as I shall try to show. Yet at the outset I must also be candid enough to note that in historical perspective their present expectations may well be exaggerated. My familiar acquaintance with the humanities in America goes back to 1932 when I entered Indiana University. During the intervening period support for the humanities has increased by an order of magnitude. Even over the past six or seven years what they have experienced is not so much a falling off as a status quo ante or "steady state" condition, in which their disappointment has arisen from expectations of continued growth that were perhaps unwarranted. Our learned world remains a privileged, even a pampered society, which takes for granted services and opportunities which would have seemed marvellous 40 years ago. We need to strike a balance between the hopelessness of the mid-1930s and the euphoria of the mid-1960s, with a view to concentrating moderate additional support in essential areas. I shall try to persuade you that this is a task in which foundations can be uniquely useful.

In concluding this preamble, I should add that I am going to limit my consideration of specific conditions and issues to the United States, even though ours is an international conference. This is the country I know best, and in the western world, at any rate, it has been the testing ground for not a few significant social developments during the twentieth century. As an American poet has written:

> So leap with joy, be blithe and gay,
> Or weep my friends with sorrow.
> What California is today,
> The rest will be tomorrow.

The credo of liberal education has been stated many times, but never better than by John Henry Newman. His central propositions may be summarized as follows: (1) "Knowledge is capable of being its own end"; indeed, "there is a Knowledge which is desirable, though nothing come of it, as being itself a treasure, and a sufficient remuneration of years of hard labour." (2) The aim of liberal education is the formation of a habit of mind lasting through life which is marked by "the power of viewing many things at once as one whole, of referring them severally to their true place in the universal system, of understanding their respective values, and determining their mutual dependence."[3]

Even with today's vocational emphasis this faith still sustains most of our best students, and not merely those in the humanities. Indeed, it is almost a prerequisite for fine work in the world of learning. Over the last few years we have heard many expressions of surprise, and even indignation, from hard-headed university administrators because the sharp decline in jobs for new humanities Ph.D.'s has not been accompanied by

an equally sharp decline in graduate enrollment. After all, they point out, the artificial prop of draft avoidance disappeared some time ago. But consider once more the precedent of the 1930s. Students persisted in taking doctorates in English, history, and philosophy throughout that dark period, even though virtually no teaching job existed. A good many young men and women were convinced then, as they are today, that there is "a Knowledge which is desirable, though nothing come of it, as being of itself a treasure."

I should make it clear that I am speaking of liberal education in a general sense, not as the end product of formal courses in a college or university. Indeed, liberal education is largely self-education; it results from the studies we undertake because at the time they are more absorbing than any other activity. How does one in practice acquire an intuitive sense of man's social, psychological, and moral life, and thereby achieve some understanding of the human condition? In part by first-hand experience, no doubt, but this is a slow and confusing process. Current information offered by newspapers, magazines, television, and radio is an extensive but superficial and repetitive supplement to experience. The systematizations of such information proposed by social scientists are inconclusive, to use no harsher term. Contemporary works of art, whether they be novels, poems, plays, paintings, photographs or films, can make a profounder contribution, since art in its way may be truer than any factual record. But with regard to understanding the human condition, our chief resource remains as always the inexhaustible heritage of the past, not merely as set down in history and biography, but also as preserved in those classics in which the mind of man has found its finest expression: his great revisitable achievements in literature, painting, music, and the other arts. Just as one euphemism for death is "joining the majority," so most of the great books were written in the past, and most interesting men and women and most significant events now belong to history. To limit one's horizon to the contemporary scene is to live as an intellectual shut-in. Here is the testimony of a fellow foundation officer, Mr. Harold Howe, on the way in which access to the past can add to one's awareness of life.

> Is there anything wrong with people pursuing more education just to satisfy their curiosity even though they may not need it on the job? What's the matter with intellectual hobbies created and nourished by education? I have an amateurish interest in the 19th century poets. I can quote yards of their verse; I waste a fair amount of time reading it; I can't think of any use for it at all in any of the numerous jobs I have held. I happened to pick up this avocation from a marvellous old gentleman named Chauncy B. Tinker, whose course I took at college, and I continued to find it a pleasant addition to my several windows on the world.[4]

It may be urged that the benefits I have so far claimed for familiarity with the past operate chiefly with respect to the individual's own development. His experience of self-fulfillment makes life more agreeable to him, and he is a more interesting person. But how does this self-education contribute to his usefulness as a citizen? Above all, I would say, through the flexibility and maturity to which it leads, to his understanding that there are no final solutions to human problems, only sensible choices among alternatives.

At the very least a dimension has been added to his outlook. He knows that there is a provinciality of time as well as of place. By studying the past he comes to think in terms of the long-time continuity of life. In his Agricultural Origins and Dispersals, a magisterial review of what mankind has done with the plants and animals among which it lives, Carl Sauer points out:

> Our civilization still rests, and will continue to rest, on the discoveries made by peoples for the most part unknown to history. Historic man has added no plant or animal of major importance to the domesticated forms on which he depends.... We remain a part of the organic world, and as we intervene more and more decisively to change the balance and nature of life, we have also more need to know, by retrospecitive study, the responsibilities and hazards of our present and our prospects as lords of creation.[5]

Changing the focus from pre-history to the twentieth century, it may be noted that the problems of Belfast and South Boston, of Cyprus and Beirut, cannot be comprehended outside of their historical context. No one can begin to appraise the situation in these places unless he knows how the patterns of the past circumscribe possible lines of action in the present.

Then the exploration of the past can also encourage the development of a disinterested habit of thought in general, a generous and enlightened open-mindedness. Much of what is written about the present is either disguised or open propaganda. We are apt to regard our columnists and investigative reporters, for example, as if they were guard dogs, and prize them for their effectiveness in leaping at the jugular. But what is needed in dealing wisely with human affairs is not partisanship but a capacity for weighing probabilities. This is what Justice Frankfurter had in mind when he wrote that "the mark of a truly civilized man is confidence in the strength and security to be derived from an inquiring mind." Moreover, it is through choices based in objective inquiry that one becomes an individual, and by encouraging individuality our society can best resist what Mr. Norman Mailer has called "the oncoming hegemony of the technological person."[6] Every day brings new evidence of how radically the capacity for independent, creative thought is being curtailed by the sort of dehumanized training now regarded as appropriate for positions in the bureaucracies of government and of business.

Throughout my argument I have advocated a detached and relaxed approach to the past. Of course one forms strong allegiances during one's explorations, but the experience that results from the very process of immersion in the past has its own value. As Joachim du Bellay, author of the Défense et illustration de la langue française, wrote four centuries ago: "Heureux qui, comme Ulysse, a fait un beau voyage." Through dedication to some aspect of historical study--and to my mind the process counts for more than the specific subject--one can gradually achieve what might be called "the freedom of the past," in the sense that worthy strangers used to be given the freedom of a city, that is to say the rights and privileges of citizenship pertaining thereto. Admission to the "freedom of the past" on these terms can lead to a feeling for the recurring patterns of human behavior and thereby to an intuitive perception of the possibilities and limitations of human life that is attainable in no other way. Nor should I omit another bonus in this sort of attitude towards the past. It offers an unfailing alternative to the insistent, mind-devouring trivia of the mass media. When you read a real book, you have the assurance, which is not easily achieved in a society where entertainment and even information are increasingly linked to advertising, that your attention has not been bought and paid for.

There are certainly more people in our time than ever before who enjoy the kind of familiar access to the past that I have described. Yet there also appears to be more resistance than ever before to going through the self-education needed to achieve this access. The uninitiated have always felt that much reading is a weariness of the flesh. There is a lithograph by Gavarni, for example, which shows a bedraggled loafer gazing at a second-hand bookstall on the banks of the Seine. He is saying, with supreme contempt: "If I knew how to read, I wouldn't read old books like those." On a more sophisticated plane people of a certain temperament have always felt that concern for the past was the

mark of the antiquarian, a characteristic of those content to exist on the margin of life. To such unbelievers the apparatus mentioned earlier for preserving and renewing humanistic knowledge seems a vast, miscellaneous anthill of activity, depressing to contemplate.

No doubt it is in part to counter such an attitude in themselves as well as in others that some scholars insist on seeing the past as an extension of the present and on employing it primarily as an arsenal from which to draw weapons for use on today's battlegrounds. This was the guiding motive of radical critics in the 1930s and again in the 1960s. What they conceived to be the social and political necessities of their own time dictated their choice of historical subjects to study and teach as well as their view of these subjects. Their work abundantly illustrates the maxim that for the politically motivated the best way to handle the past is to misinterpret it. Another sort of polemical aim lay behind the "great tradition" set forth by F.R. Leavis, the chief defender of the humanities against C.P. Snow's advocacy of science in the famous debate of the early 1960s over the "two cultures." It was Dr. Leavis's dubious achievement to reduce the endless variety and profusion of English literature to a handful of poets and novelists who for him best demonstrated the ideals to which he wanted human nature and society to conform.

This tendency to see the past through the present now has a disturbing currency, particularly among the young. Last year the authors of a study sponsored by the Organization of American Historians deplored the increasing prevalence of "presentism," as they called it, that is to say an exclusive preoccupation with current events taken out of their historical context.[7] Teachers of literature are conscious of the same tendency, intesified in their field by a special heritage from the 1960s. In an essay significantly entitled "After Turmoil, After Torpor," Mr. Irving Howe reported:

> Even with the best of our students one senses more and more a phenomenon I would call the "pastness of the past," how the accumulating historical distinctiveness of our lives seems to drive a wedge between ourselves and our culture. Insofar, for example, as English literature rests on norms, premises, beliefs, and even memories of the Christian-Classical tradition, we may suppose that a reader who has grown up in our largely post-Christian culture will find himself increasingly tone-deaf to the works of the past.[8]

Our society needs a breathing space in which to overcome the discontinuities induced by the troubles of the last decade. There is a current rash of works predicting the end of culture, practically every one of which, as a critic has noted, is "a book in search of a magazine article." This will pass, but time is required to re-establish intellectual authority and to restore the distinction between the serious and the frivolous esteem of mankind which used to afford some protection to learning. Keeping humanists and their institutions viable during this period is an urgent and difficult task to which a high priority should be assigned.

If the humanities are to be supported in a democracy, there is an initial obligation to show that humanists and their institutions so order and present the past that it is of useful service to the public generally. This obligation was often ignored in earlier years, when enlightened patrons moved by a spirit of noblesse oblige provided cultural institutions with the financial support that they required. The amenities possible under such a system were substantial, and one relinquishes them with reluctance; but except for a few strategically situated institutions, basic reliance on the support of private individuals is no longer possible. The hard questions of those holding the purse strings of philanthropic or governmental organizations--managers, bureaucrats, and legislators--now have to be answered; it is not easily presented in the sort of concrete way that such

persons find convincing.

The humanities stand for quality and superior accomplishment. The humanist examines the past with a view to determining what from it continues to deserve active attention. For every book, picture, or musical score that he proposes for study, he leaves a thousand on the shelves or in storage. These chosen works, moreover, have to be approached on their own terms if they are to be fully understood and appreciated, and such an approach presupposes both knowledge and sophistication. This equipment is not something with which an individual is born, and yet without it the humanities are only marginally accessible.

Moreover, the possession of such background knowledge is apt to put the humanist in a difficult position with regard to the great public. The scientist's special knowledge is so esoteric that the average man or woman feels no uneasiness about not possessing it. The humanist's enhanced understanding, on the other hand, is a deepening of comprehension about things that concern the average man and woman as human beings. They have their own perceptions about these things, and they are understandably reluctant to grant the humanist the kind of authority that they willingly concede to the scientist. When he sets out to enlighten them, they may attribute to him a supercilious, holier-than-thou attitude which usually is not there. Yet taste based on special training is a good part of what the humanist has to offer. When a disgruntled member of an audience addressed by Mr. Saul Bellow complained about one of his judgments: "That's only your opinion," he replied: "What do you want? Parings from my finger-nails?"

I don't want to appear mystical, or to ask you to go into a trance to get my meaning, but at this point an act of faith in the humanities is called for. The sort of knowledge and taste necessary to their full appreciation is likely to remain the possession of a relatively small group of highly trained people, yet this group is the leaven that leavens the whole loaf. Without it even the partial comprehension of the great public would not be possible. Moreover, it may be hoped that, with the expansion of education and leisure through the passage of time, a larger proportion of the public will achieve more complete appreciation. Here one may cite the evidence of Mr. John Canaday's valedictory article after seventeen years as art critic with the New York Times. Maintaining that "what we were calling a cultural boom in 1959 has become in 1976 a deep-rooted cultural growth that has yet to come to full flower," he affirmed his belief in "a kind of cultural osmosis by which the deep pleasure experienced by a small portion of the public is symptomatic of an increased capacity for pleasure that has seeped into the subconsciousness of the many."[9]

I had planned to avoid all mention of America's Bicentennial, a topic concerning which there would seem to be little more to be said now, yet its evidence regarding the possible uses of the past is too striking to omit. Certainly American humanists and their institutions were not backward in celebrating this anniversary. There were some efforts that made their impression on the general public and at the same time pleased the experts: "The Adams Chronicles" on television, for example, and Mr. Page Smith's A New Age Now Begins: A People's History of the American Revolution. But for the most part successful Bicentennial celebrations seemed to find either a small, specially prepared audience, or a large, undifferentiated audience. Nearly all of our great museums and libraries mounted exhibitions on which their notable historical treasures were splendidly presented and recorded for posterity in superb catalogues. For example, the exhibits at the Smithsonian Institution, fondly called the "Nation's attic," included Abroad in America: Visitors to the New Nation, 1776-1914 at the National Portrait Gallery; The Eye of Thomas Jefferson at the National Gallery of Art; America as Art at the National Collection of Fine Arts; and, A Nation of Nations, and 1876: A Centennial Exhibition both mounted by the Museum of History and Technology. Indeed, the

exhibitions shown throughout the country were accomplishments of which any nation could be proud, but attendance at them ranged for the most part from moderate to meager. What did catch the attention of the great public were spectacles devised to mark the occasion: the Queen's visit, "the tall ships" sailing up the Hudson, 50 marching bands in Philadelphia on the Fourth of July, and so on. As for the mass media, "show business" took over. Their most insistent and obvious Bicentennial contributions came in the form of one-minute spots publicizing minor personalities, apparently recruited chiefly from the entertainment world ("I am so-and-so. Two hundred years ago today, etc.... I am so-and-so.") These did not constitute a major cultural advance.

We may pass now from the value of the past to the individual and society to the apparatus by which the study of the past is kept alive. Perhaps we don't sufficiently realize what a new thing it is in human history to have at our service such extensive and effective machinery for exploring and reporting upon the past. May I offer a comparison drawn from my own experience? As a combat intelligence and fighter director officer aboard the aircraft carrier Belleau Wood in 1943 and 1944 it was one of my duties to master the successive operations orders received during the United States Navy's island-hopping campaign in the Pacific. Though the background data in these documents were prepared by experts from our best universities who had full access to the resources of the Library of Congress, the information provided about the Gilbert and Marshall Islands, Truk, Saipan, Guam, Okinawa, and the rest was not greatly in advance of what was available to Captain Cook in the eighteenth century. Today encyclopedic data are on file about all these islands, as they are about every other conceivable subject. This fact is constantly brought home to me through my job at the Guggenheim Foundation, which gives me an opportunity to observe the development of knowledge on a broad front. We receive some 3,000 Fellowship applications each year from advanced workers in nearly all fields of learned, scientific, and artistic activity. About a third of these are in humanistic subjects, which include not only the humanities proper, but also the humanistic aspects of other disciplines. Indeed, even scientists sometimes propose humanistic projects to us. Mr. James D. Watson's The Double Helix, for example, was written in part on a Guggenheim Fellowship.

In every one of these fields one can see how the accretion, analysis, and reinterpretation of knowledge is slowly altering the way in which the past is regarded. From time to time the broad results of such changes reach the public in dramatic form. The role of women in history has recently been radically restated, for example, as has that of blacks, particularly with regard to slavery. Such an altered consensus can have substantial practical effects. It can determine what judgments are rendered in our courts, who is elected to office, and what laws are passed. Far more important than these incidental consequences, however, is the assurance that the process itself continues unceasingly in every field, that everywhere fresh work is being done and its implications for existing knowledge are being appraised, that there is no subject without devoted students to whom it is a matter of vital concern. This is a national resource of incalculable value.

The central work of keeping the past available in current form is carried on for the most part in colleges and universities, in independent research libraries and museums, and in centers for advanced study, with the learned societies performing essential coordinating and facilitating services. The results of this continuous process of investigation, analysis, and synthesis are made available through books and journals published by university presses and trade houses of scholarly orientation. The massive structure of organized learning thus achieved has become so familiar a part of the contemporary scene that its invulnerability is taken for granted.

Publishers of popular books and magazines assume that it will continue to provide them with data in profusion. The entertainment and advertising industries see it as an unfailing source for the retrospective materials that they need.

Unfortunately this vast apparatus of learning is by no means an inalterable fact of nature. It has attained its present proportions since the Second World War through a combination of circumstances that will not recur. Not merely has its growth ceased, but it is manifesting an inability to continue even at its present level. Here are some fissures to be observed in what once appeared to be an impregnable monolith. Universities seeking to make ends meet in a time of inflation have pared their budgets sharply in areas which affect the humanities. Since the vocational orientation of the present generation of undergraduate students has reduced enrollments in humanities departments, staff cuts have occurred there. There is little demand for new teachers in the humanities, and doctoral programs in these fields have accordingly been reduced and in some cases eliminated. There are more applicants for fewer research fellowships for the senior humanistic scholar, and his prospects of achieving a free year to pursue a big project have been materially reduced. Publication costs have increased by a factor of two or three in the past decade; hence both university presses and scholarly trade houses find it difficult or impossible to accept specialized humanistic manuscripts, which rarely paid for themselves even under the favorable conditions of the past. Since journals, the significant form of publication in the sciences, have grown more numerous and more expensive, university libraries are buying fewer books, the significant form of publication in the humanities. Moreover, nearly all independent research libraries have sizable operating deficits and are accordingly showing an increasing inability to offer the services which have previously made them indispensable to humanistic scholars. These are some of the formidable practical problems to which those desirous of aiding the humanities should apply themselves.

If the importance of the humanities to society's well-being is recognized, from what sources is there hope of obtaining the assistance they must have? As far as colleges and universities in general are concerned, the nation-wide need for student scholarships, staff salaries, and library additions is of such magnitude that it can be met only through recurring appropriations by the Congress and the legislatures of the several states. Selected individual institutions can be helped in a useful way by private as well as public funding, however, as can independent research libraries and museums, learned societies, and university presses.

The National Endowment for the Humanities, authorized by the Congress in 1965, has since achieved a size that could hardly have been predicted. In 1975 its budget of $79.5 million exceeded the $ 65 million given in the humanities by 312 large foundations as reported in the Foundation Grants Index of the Foundation Center. The Endowment's emphasis on "the value of the humanities in relationship to people's lives" has led to an extensive program of fellowships for humanists as well as much research assistance. It has also made grants to humanistic institutions, most notably and courageously to the New York Public Library. A particularly useful feature of its program is its ability to match gifts from other sources. Needless to say, the Endowment has been a godsend to the humanities. Yet its program excludes major areas of need (operation expenses, construction costs, publication subsidies, etc.), and it is bound by the stringent limitations under which every governmental organization must work. The well-known "G-factor", that is to say the expectation of wide geographical distribution in grants, is no less potent than in other federal programs, and bureaucratic formalities, restrictions, and delays are formidable.

It might be thought that the $ 65 million given in the humanities by the larger foundations in 1975 is also a generous sum, but in fact it represents only 9% of their grants. Despite the fact that the proportion so allocated has remained fairly constanct (8% in 1972 and 11% in 1974), the humanities have recently had their striking ups and downs in the foundation world. No doubt influenced by the growth of the National Endowment for the Humanities, the Ford Foundation, which had previously been the big presence in the field, discontinued its Division of Humanities and the Arts after the retirement at the end of 1974 of Mr. McNeil Lowry, the Vice President in charge. The humanities were reassigned to the Division of Education and Research, where new grants have been minimal, though Ford's support of such organizations as the American Council of Learned Societies and the Council on Library Resources continues to be invaluable. The Rockefeller Foundation had once provided substantial funding in the area. After a virtual hiatus of some years, its trustees in 1974 "called for renewed attention to the humanities," in the hope of illuminating "our understanding of human nature in the late 20th century world." This promising program is in the process of implementation. However, the major addition to the foundation scene in this context is the Andrew W. Mellon Foundation, which places central emphasis on the humanities. Since its formation in 1969, it has provided large-scale support in many areas of humanistic concern. Apart from these giants, the prospects of help are scattered and uncertain, though I may perhaps be permitted to reiterate that each year the Guggenheim Foundation awards many of its fellowships to advanced humanistic scholars as it has throughout the last half-century.

I suggest that the time is ripe for some change of attitude towards the humanities on the part of foundations. Matthew Arnold once complained that "Wordsworth's eyes avert their ken/ From half of human fate." Given their preoccupation with innovation, I wonder if foundation trustees and officers don't have a similarly extensive blind spot. In their professional journals, for example, they are constantly assured that "the genius of America is controversy, not consensus," urged "to get a bigger bang out of the buck," and told that they must achieve the perspective that comes from being "poor, black or brown, female, powerless." This sort of conditioning puts them in what amounts to an adversary position with regard to the past. Some time ago I was invited by a foundation president to talk with him and his chief associates about a program for aiding the humanities which his organization had under consideration. It was a strange session. After my description of each step that might be taken, one of the vice presidents would inquire: "how would that help ethnic minorities?" He was a worthy, if literal-minded, man and I tried to suggest that long-term benefits in the way of softening or removing prejudices would be substantial. I think now that I should have said simply: "What would your response be, if you were asked concerning your program for ethnic minorities, how would it help the humanities? If you want to help ethnic minorities, help ethnic minorities. The humanities claim assistance in their own right, not for the peripheral benefits that may accrue in other areas." It appears that corporations are finding "resident humanists" useful in broadening the outlook of their officers and staff. Perhaps the same device should be adopted by some of the larger foundations.

There is also a consideration of some delicacy that nonetheless has to be mentioned. The influence of foundations in American life is much diminished. There was a time when the Rockefeller Foundation's stated aim of advancing "the well-being of mankind" was in fact tangibly realized from year to year. Today only the Rev. Sun Myung Moon feels comfortable in boasting that he will achieve "the betterment of mankind."[10] The kind of financial leverage necessary for programs of general human improvement now belongs to government, not to private philanthropy. Confined to more limited objectives, foundations would do well to ask themselves where the funds they have available will in fact make a

significant difference. The needs of the humanities are concrete and critical, and modest sums of money applied to them can be of immediate and solid benefit. Foundations should consider the claims of scholars in the humanities, their indispensable auxiliaries (librarians, curators, and the rest), the learned societies which coordinate their work, the graduate students who will carry on their disciplines, their workshops (chiefly libraries, but also centers for advanced study), their display cases (chiefly museums), and their means of communication (books and journals, particularly as published by university presses). And in making decisions as to where assistance should go, the basic criterion should be the quality of work performed in the past and hence likely to be performed in the future. It doesn't have to be emphasized that, in respect to supporting excellence, private foundations have a freedom of choice not always open to governmental organizations.

In my discussion I have not specified individual institutions that deserve foundation help, but there is one whose position is so outstanding and whose need is so dire that I must not conclude without mentioning it. This is the New York Public Library. Its research collection is one of the half-dozen greatest in the world, and it has a proud history of vital service to generations of students and scholars, indeed in countless cases, of students whom it has made into scholars. Despite the word "public" in its name, it has in fact always had to depend primarily on financial sources other than the city. In the New York of today, where the work force of city employees has been cut to the bone, where the schools are understaffed, and where police, fire, and sanitation protection is below the level of safety, this dependence has become more absolute than ever before. The services offered by the research collection of the New York Public Library have already been drastically curtailed, and without major gifts in the near future, the doors of its main building at Fifth Avenue and 41st Street could well be closed. Recognizing that this was a case to which its usual guidelines did not apply, the National Endowment for the Humanities has given the New York Public Linrary an unprecedented $ 4,375,000 over the past five years, with the prospect of even larger grants to come. This exceeds the $ 3,364,000 in general purpose grants which the Library has received from Foundations during the same period, despite a gift of $ 1,000,000 from the Mellon Foundation. The Astor Foundation has also made a $ 1 million special-purpose grant. Since many of the country's largest foundations are based in New York, where their staff knows the Library well through constant use, this relative neglect is particularly surprising.

A philanthropist is by definition a friend of man. The example of the past, particularly as it makes possible "the habitual contemplation of greatness,"[11] is essential if men are to become their best selves. No doubt the demands of practical life make such contemplation difficult to encompass, but it ought at least to be within everyone's reach. I have tried to suggest that this essential resource of mankind cannot survive unless we go on supplementing "the current enlightenment of the epoch" by maintaining the past in "a dignified independent existence of its own." I don't see how philanthropy could have a worthier aim.

Notes

[1]Quoted by Gunther S. Stent, "What They are Saying about Honest Jim," Quarterly Review of Biology, 43 (June 1968), 183.

[2]P.G. Hamerton, Etching and Etchers (London, 1868), p. 123. The poet was presumably Matthew Arnold.

[2]Discourses on the Scope and Nature of University Education (Dublin 1852), pp. 170, 188-189, 217.

[4]The Value of College: A Non-Economist's Point of View (New York: Ford Foundation, 1976), p. 15.

[5](New York 1952), p. 104.

[6]New York Times, 16 August 1976, p. 37.

[7]New York Times, 12 August 1975.

[8]ADE Bulletin, February 1975, p. 4.

[9]8 August 1976.

[10]Time, 14 June 1976, p. 48.

[11]Quoted from Alfred North Whitehead by J. Carter Brown in his preface to The Eye of Thomas Jefferson (Washington: The National Gallery of Art, 1976), p. ix.

THE SUPPORT OF THE SCIENCES IN THE UNITED STATES

J. Thomas Ratchford

It is a great pleasure to participate in this discussion of the support of the sciences and humanities in West Germany and the United States. My own background and perspective is that of the physical scientist, and I was a physics professor in my youth. This has been altered somewhat in recent years as my interests and responsibilities have shifted from the laboratory and classroom to the policy arena, including the funding of science and technology in the Executive Branch and the Congress.

Today I am representing the American Association for the Advancement of Science or, as we usually refer to it, the AAAS. The AAAS has about 120,000 members and, in addition, represents almost 300 affiliated scientific societies, including the social as well as the physical sciences. Science, the Association's journal, is the premier multidisciplinary scientific journal in this country, and is read by scientists in every nation of the world. The pages of Science regularly report on the status of funding for scientific activities in the U.S.

Last year the AAAS and its Committee on Science and Public Policy undertook the preparation of a comprehensive analysis of the U.S. Federal R&D budget. With continued funding from a private philantrophy, the Sloan Foundation of New York, this analysis is being repeated for the Fiscal Year 1978 R&D budget now under consideration by the Congress. Authored by the well-known budget expert, Willis Shapley, these documents serve as one source of the information I shall discuss with you for the next few minutes.

It is hard to know where to begin a discussion of financial support for U.S. science. On the one hand it is tempting to plunge immediately into statistics that quantify our science effort. On the other hand, probably of more importance than mere dollars or even trends of support is the underlying rationale for supporting science in the public and private sectors, as well as the process by which funding decisions are made. I shall compromise by doing some of each.

First let me throw out a few numbers. Former President Ford requested budget authority for R&D activities during fiscal year 1978 totalling $ 28 billion when the budget was submitted in January of this year. President Carter has reduced this by $ 300 million, about 1 percent. This compares to total Federal budget requests of $ 480 billion by Ford and $ 507 billion by Carter. We see that R&D represents slightly over 5% of the Federal budget. Another profitable comparison is with our total Gross National Product, or GNP. In fiscal year 1978, our GNP in this country is estimated to be about $ 2 trillion. Federal R&D funding thus totals about 1.3% of GNP, down from 1.5% in 1972 and down substantially from the level of the late 1960's.

The Federal government is only one source of support for science in the U.S. Private industry, universities, other nonprofit institutions and foundations also provide important funding for science.

Private industry spent $ 16.5 billion of its own money on R&D in fiscal year 1976, the last year for which industry figures are available. Total Federal funding that year was $ 22 billion, and over $ 10 billion of that went to industrial performers.

The other sources of R&D funds are small by comparison with the Federal Government and industry budgets. The total for these other sources, universities, foundations, and other nonprofit institutions, runs about $ 1.5 billion annually.

So far I have been referring to fiscal terminology and funding totals quite carelessly. I shall now take a moment to elaborate on terminology and point out some caveats regarding dollar totals.

R&D means many things to different people. The Federal government attempts to classify its R&D funds by character of the work accomplished. The major sectors are:

1. Basic Research,
2. Applied Research,
3. Development.

Federally supported basic research represents about 10% of the total; applied research a little more than 20%. The remainder, two-thirds of the total, is classified as development.

There are even graver problems in characterizing R&D supported by private industry. Until 1973 there were wide variations in standards used for classifying R&D expenditures. For example, companies often classified as R&D such items as surveys of customer preferences and other marketing costs. In 1973 this state of confusion led the Nation's accountants to carry out a study of the problem, and in mid 1974 the Financial Accounting Standards Board adopted standards that included a definition of R&D. That definition follows closely the one used by the National Science Foundation and the Census Bureau. R&D includes all costs associated with the search for and discovery of new knowledge that may be useful in developing new products, services, processes or techniques. Also included are design, construction and testing of prototypes and the operation costs of pilot production facilities. Costs that cannot be classified as R&D include routine product improvements, regular or seasonal style changes, testing of production products, and quality control tests. Also excluded are engineering follow-through in early phases of commercial production, market research costs, and the legal costs of patent applications as well as the sale and licensing of patents.

These changes in accounting standards have resulted in much more accurate reports being submitted to the Securities and Exchange Commission in the "official" annual reports of U.S. industrial concerns. In this country all public corporations must file annually a Form 10-K which, since 1970, requires separate listing of R&D expenditures.

These standards of R&D accounting do not, however, break down expenditures into separate research and development categories. There is much disagreement over what is research and what is development, and this persists in the absence of a breakdown between research costs and development costs in industry.

The aggregate effect of this support of R&D by private industry is substantial. For 1976 the expenditure of $ 16.5 billion represents about 1% of our GNP for that year. Added to the Federal support of R&D and the one and a half billion dollars of funding by universities, foundations, and other nonprofit institutions we find the total approaching $ 40 billion, or 2.4% of our GNP. This is truly a substantial commitment of our national wealth.

I fear that I may have bored you with this dull recitation of budget totals and accounting standards. But what we have done so far is to put the support of science in perspective in a quantitative sense, in terms of those variables of which we, in the United States, all have at least a passing knowledge: the GNP and the budget of the Federal Government.

We have not discussed the much more important topics of why we as a society fund R&D, and the process by which we decide to allocate these resources among competing activities.

Before doing so I would like to say a further word about nomenclature. The title of my lecture is "The Support of Science in the U.S." My discussion so far has centered on R&D budgets. You might well object to equating science to R&D. This equation implies that we have an interest in the funding of research on a new soap powder but are willing to ignore funds allocated to an innovative new science education project. I cannot defend against such an argument, except to say that the changes in the funding totals that would result from such careful adjustments to the R&D figures are probably well within the

uncertainties of the R&D totals themselves. These uncertainties, by the way, are somewhere around 20% of the figures I have been using. One can also point out that it is R&D funds that pay for most advanced education in science and engineering in this country, and it is this education at the graduate and postdoctoral levels that is the most expensive.

You may also object to the inclusion of development costs under the category of support for science, especially since they represent about 70% of the total R&D funds. Here I feel a bit more comfortable, however, since the processes for generating new scientific knowledge and the development of practical gadgets utilizing that knowledge have been inextricably intertwined in the past. Further, as I shall discuss shortly, the rationale for funding science cannot be separated from the practical implementation of that scientific knowledge.

Let me now address the question of why we in the U.S. support science. At one level of understanding the answer is quite simple. Science is thought to be useful in accomplishing the practical goals of the nation, or is perceived to produce new goods and services that in turn increase profits in the private sector. Fundamentally we support science because past experience has shown that it is a good investment.

At the Federal level, we have supported science since the early days of this republic. The Constitution recognizes this need and provided for a patent system as one way of obtaining practical benefits from scientific knowledge and innovation. Before the Civil War the Federal Government became concerned with the large number of explosions that were occurring on steamships because of boiler rupture. The result was a contract with the Franklin Institute of Philadelphia to carry out an R&D program on ship boilers. Happily the problem was solved.

Over the years the Federal Government has generally provided R&D funds because the President and the Congress have been convinced of some practical future payoff.

These funds were a trickle until the Second World War, and were aimed at the development of military weapons by and large.

The Second World War changed the view of this country and its government toward science. The massive and successful efforts to develop a vast array of tools of destruction, from radar to the atomic bomb, resulted in a situation where the public, Congress and the President felt a debt of gratitude to the scientist and engineer. A realization of the value of the great laboratories built during the war led to steps that institutionalized their existence and associated some with the title National Laboratory. The scientists fleeing the postwar terror in Europe joined those who fled to America before the war, and settled down to practice their now noble art of scientific discovery.

Vannevar Bush, who guided the U.S. scientific effort during the war authored a report entitled "Science, the Endless Frontier." This report implied a better life for all if nature were brought under control of the benevolent scientist.

Basic science in particular received much of the credit for the wartime successes. Many of the leaders in wartime development projects were in fact basic research scientists. And the incredible speed with which the atomic bomb evolved from idea to weapon of terror magnified this perception of the power of science and its practitioners.

The result of all this was a plethora of new organizations and a torrent of funds. The Atomic Energy Commission, the Office of Naval Research were new names that represented large and growing budgets. Basic research was recognized as important by all of these agencies, and their funds flowed to universities, industries and new centers of scientific excellence with names like Brookhaven, Los Alamos and Argonne.

The country hardly had time to celebrate the end of the war before the cold war set in in earnest. The hydrogen bomb was developed successfully. The missile gap was perceived and then closed at a cost of many billions of dollars. And along with these military

development programs came funds to train the needed scientists and support the research of their faculty advisors.

American science received another gigantic financial boost in 1957 when the Soviet Union launched Sputnik. The national commitment to go to the moon not only produced Apollo--it also gave us earth resources satellites, NASA supported laboratories at our universities, and NASA traineeships that supported graduate students in disciplines related to space technology.

It was a little more than halfway through the Apollo program that funding for science reached its high water mark in the U.S. In the late 60's we invested about 3% of our Gross National Product in research and development, compared to the 2.4% we invest today.

The widespread perceptions of success for American science and technology had some interesting policy ramifications. A few years ago the Director-General of Le Plan, the superb process by which a consensus is reached for economic and social development in France, appeared before the Committee on Science and Astronautics, as it was then called, of the House of Representatives, to testify on the Gaullic approach to R&D planning. This extremely capable gentleman, Monsieur René Montjoie, explained in great detail how the various sectors of the French economy and society reached a consensus on the magnitude and directions for research and identified the major development objectives of the French economy. It was with disarming candor, then, that in reply to a question on the ultimate goal for the level of support for French R&D he stated that the goal was 3% of GNP. The rationale? That was the American level, and it seemed to work here!

The period of monotonic increases in the proportion of our national wealth devoted to R&D did come to at least a temporary halt a few years ago. This was accompanied by widespread concerns over the state of our national environment, the development of controversial weapons systems, and a perception by many concerned citizens that science and the complex technologies that it spawned might not always improve the quality of life and the social order. A reaction clearly had set in, and anti-science or anti-technology groups sprang up here and there. But for all thoughtful people the values of the humanities have, I believe, been recognized as being of equal importance to those of the sciences. Our young people today are asking why as well as how.

I would also like to raise the question at this point of why industry makes the investment it does in R&D. A 1974 issue of the Standard and Poor's publication that analyzes and projects business and market trends contained a special study on R&D in industry. Permit me to quote:

> "The importance of research and development work is obvious: it is the source of new products that can add to sales, and of new and improved processes that can cut costs. Thus, the productiveness of a company's R&D effort is a key determinant of its rate of earnings growth and of its stock's potentials."
>
> It goes on to say, "... the R&D-oriented industries such as drugs, chemicals and electronics are clearly growth industries. Since factors like marketing skills and the long-term uptrend in consumer affluence can also contribute to earnings growth, there is no absolute correlation between R&D outlays and P/E ratios. But the odds are that a fast-growing manufacturing company has a well-run R&D program."
>
> The analysis concludes, "Obviously, R&D data for individual companies and industries require interpretation before they can be employed as a basis for investment action. Nevertheless, R&D policies are a valuable clue in the identification of growth potential."

Private industry clearly supports science and technology for one fundamental reason: it leads to future profits. Thus we find four U.S. companies each with R&D budgets of over one-half billion dollars annually.

The details of how R&D produces profits and the specific causal relationships are still unclear, in spite of the better statistics and a greater effort to analyze them. The situation was well summarized in the Business Week magazine survey of corporate research and development published in mid-1976 which said:

"Corporate executives, economists, engineers, and scientists all broadly agree that the nation's growth and security depend directly on the ill-defined range of activities called research and development. Despite this consensus, the picture of how R&D works, where it is done, and who does what is murkey."

Having attempted to shed some light on the question of why we in the U.S. support our scientific establishment, let me now address the issue of how such decisions are made in the public and private sectors.

First let's consider private industry. Here I'm afraid I shall have to resort to some generalities and hand waving. My impression is that successful R&D programs in private industry depend on the simultaneous presence of at least the following characteristics: competent scientists and engineers with a special expertise in those fields of technology in which the company excels, both in technology and marketing. I suspect that careful management, good luck and intuition are also necessary. In any case, we see that $ 20 billion annually of private resources are devoted to R&D with the expectation of future gain.

Universities support science because it is a part of their educational and research objectives. Many younger faculty members receive their first research grant from their own university, with the mutual expectation that this will launch them on careers that will include future Federal benefactions.

Private philanthropic foundations support science for many of the same reasons as industry: the results of research are expected to provide the means to accomplish certain stated goals. R&D is deemed to be cost-effective when judged against alternative strategies. The results have been impressive in fields such as agriculture (who has not heard of the green revolution?) and family planning. The manner in which funding decisions are made also seems straightforward. Proposals are submitted to foundation officials in areas of known interest or, in other cases, the officials seek out those scientists with the required expertise and experience.

Decisions to fund research projects follow much the same pattern in the Federal Government, once the funds are made available to the government agencies. The process of obtaining the funds from, ultimately, the taxpayer is not quite so simple, however. There is the complex procedure of budgeting, where the agencies develop requests from their various divisions, review and alter these requests which in turn go to the Office of Management and Budget, or OMB as it is called. The OMB then makes final recommendations to the President who submits his recommendations to the Congress.

It is in the Congress that we find the most colorful interlude in what is otherwise a rather drab and boring fiscal process. The juxtaposition of opposite views on the support of science often serves to focus the really fundamental policy questions.

Here are a few congressional views which appeared in the Congressional Record during the last few years.

"The dream of the United States maintaining its position of world leadership in all the key fields of science and advanced technology is seriously threatened ... I, for one, am not ready to accept a second-rate position for U.S. science." These words were uttered on May 11, 1970 by then Chairman Emilio Daddario of the House Subcommittee on Science, Research and Development, in justifying the fiscal year 1971 National Science Foundation budget. Mr. Daddario is now the Director of the Office of Technology Assessment and President of the AAAS.

Replying to Mr. Daddario's remarks, then Congressman Richard Roudebush of Indiana rejoined "Mr. Chairman, I agree with my distinguished colleagues that it is necessary for the United States to maintain the world leadership in science and technology. On the other hand, it is even more important to maintain the fiscal integrity of our Nation's Government."

The social sciences generally are not too popular with the Congress. During the debate on the fiscal year 1972 NSF authorization, the social sciences did not escape notice. Then Congressman John Schmitz of California stated "There has not been any discussion here about the social sciences. All the sales pitch on this bill has been on its more truly scientific aspects. As a former junior college social science instructor, I am quite familiar with the pseudo-scientific nature of many of the projects encompassed under the broad heading of social sciences. ... I just wonder how many of the Members who are going to vote on this bill are going to know what they are voting on? I think most will assume that they are supporting such sciences as mathematics, and some of the other sciences listed here. But when you look on page 3, you find that mathematics is listed for $ 15,200,000 whereas the social sciences get $ 26,300,000 which is a rather odd proportion in a bill which is being pushed as a bill to foster science."

The comment of former Congressman Roudebush on fiscal integrity was not the last word on that subject. Now retired Congressman H.R. Gross of Iowa was well known for his guardianship of the public purse. His colloquy with former Congressman John W. Davis of Georgia, then Chairman of the House Subcommittee on Science, Research and Development, further illustrates congressional concern over the inroads of academic and other scientists on the Federal treasury. You should keep in mind that Mr. Davis represented a mostly rural area in northern Georgia known for, among other things, the production of illegal or "bootleg" whiskey

> I note on page 3 of the bill there is $5,000 for official consultation. What happens in the spending of $5,000 for official consultation? Could the gentleman enlighten the House? ...
>
> Mr. Davis of Georgia: I would say to the gentleman from Iowa that is standard language that all the agencies use. It is for entertainment ... The gentleman has put his finger on a delicate nerve, and the name of the nerve is entertainment ...
>
> Mr. Gross: Would the gentleman think $5,000 was enough for all these scientists to finance their official consultations?
>
> Mr. Davis of Georgia: Well, if they would purchase, the products in my home district, it would cost less than that, although the products might be without benefit of some revenue stamps. ...

Mr. Gross did not pursue the matter further.

Now most of the real work of the Congress takes place in its standing committees. But we find there are about 30 such committees with some responsibilities over parts of the nation's scientific programs. In spite of this organizational nightmare the work does get done and the bulk of the President's recommendations are approved. For example, Congress increased Ex-President Ford's R&D budget request for fiscal year 1977 by about $ 300 million. This included a $ 420 million cut in Defense R&D, and cuts of $ 30 million for the National Science Foundation and $ 16 million for Housing and Urban Development. There were increases of $ 250 million for the Energy Research and Development Administration and $ 350 million for the National Institutes of Health. Thus we see that Congress, although it did not change the total very much, did make some substantial readjustments between programs and agencies.

Before leaving the Congress, I should like to make one more point, namely that in the context of congressional institutions, mainly its committees, individual leaders have played extremely important roles in funding scientific research. Congressman John Fogarty, Chairman of the House Appropriations Subcommittee handling the Department of Health, Education and Welfare, greatly increased the budgets for the National Institutes of Health and their extensive biomedical research programs. In like manner, Senator Lister Hill, Chairman of the corresponding Appropriations Subcommittee in the Senate, was influential in assuring more funds for NIH. Senator Hill's impact was compounded by his position as Chairman of the Senate Committee on Labor and Public Welfare, which authorizes new programs related to the health sciences.

One should not, however, overemphasize the influence of individual committee chairmen, no matter how powerful they may be. These men are often influential in part because they have taken the leadership in supporting programs with wide popular appeal -- in advancing "an idea whose time has come." Almost always the idea whose time has come is not purely scientific or technological. Rather it is usually one related to the health of our citizens, international competition in space exploration, national defense, or some other non-scientific concept. The National Cancer Institute and other parts of NIH, Project Apollo, and the development and deployment of Intercontinental Ballistic Missiles have paid for and will continue to support much basic and applied research, including research in our universities. These activities received congressional support because they reflected the desires of the constituents of the individual congressmen and senators, and correspond with their conceptions of what was needed for this country.

What, now, of the future? Will the United States continue to reduce the proportion of its national wealth devoted to science and technology? Or is this decline temporary, only a pause in the upward trend of R&D budgets?

The answer to this cannot be given without first reviewing the basic rationale for the support of science in the U.S. That rational is now and always has been that science and technology are effective tools for accomplishing national goals, whether they are national defense, space exploration, health care, environmental quality or economic growth. Budgets for these purposes ebb and flow with public concern the vagaries of the stock market, and world conditions.

An appropriate question then to ask is whether there are new problems looming on the horizon that will require massive infusions of new scientific and technological knowledge and hardware. The answer is clearly yes, and the problem is energy.

In the long run, energy policy is the replacement of old technologies with new. A gasoline tax of 50 cents a gallon and incentives for new insulation in our homes will help with our short run energy problems, but they will also add to the pressures for developing new technologies that use energy more efficiently and cleanly. My guess is that the United States will increase again the proportion of its Gross National Product devoted to science, and that development of new energy technologies will be the motivating factor.

In conclusion, let me point out that the United States has been generous in its support of science and its practitioners. In return we have received increased economic growth and a plethora of gadgets to entertain as well as perform work. Science in its application is practical, and so is rewarded by a society that takes seriously its economic pragmatism.

But let me state explicitly a point that I have alluded to earlier. Science gives us better ways of doing things, <u>not</u> better things to do. Science is a method, and technology is the result of capable application of that method.

Since science addresses means rather than ends, our society desperately needs to better define the use of science and technology within the framework of a dynamic humanism. Better relating the pragmatism of science to the beauty and ethical values found in the humanities is a responsibility that all of us--in both cultures--share. I hope we can meet the challenge.

The following tables are extracted from: Research and Development in the Federal Budget: FY 1978.

Table 1

Total R&D Budgets for FY 1978

Original (Ford) and Revised (Carter) FY 1978 Budgets

Table 1 Budget Authority for R&D in FY 1978 Budget (in billions)

	FY 1972[1] Actual	FY 1976 Actual	TQ[3] Actual	FY 1977 Est.	FY 1978 Budget
Conduct of R&D:					
Original budget	$16.5	$21.2	$5.4	$23.7	$26.4
Revised budget	16.5	21.6	5.4	23.7	26.3[2]
Same, 1972 dollars	16.5	16.1	4.1	16.8	17.6
R&D Facilities:					
Original budget	$.6	$.8	$.2	$1.6	$1.6
Revised budget	.6	.8	.2	1.6	1.4[2]
Same, 1972 dollars	.6	.6	.1	1.1	.9
Total R&D:					
Original budget	$17.1	$22.0	$5.6	$25.3	$28.0
Revised budget	17.1	22.0	5.6	25.3	27.7
Same, 1972 dollars	17.1	16.7	4.2	17.9	18.5

Source: "OMB Data for Special Analysis ," Ford Budget and Revised.

[1]Budget Authority figures are not available for FY 1972. Data shown are authors' estimates based on obligation data.

[2]The revised data for "Special Analysis P" do not include budget authority. Budget authority estimates are based on obligation data.

[3]TQ = Transition Quarter

Table 2

Conduct of R&D by Character of Work (Budget Authority in Billions)

	FY 1972[1,2] Actual	FY 1976 Actual	TQ Actual	FY 1977 Est.	FY 1978 Budget
Current dollars:					
Basic Research	$ 2.0	$ 2.5	$ .6	$ 2.7	$ 3.0
Applied Research[3]	3.9	5.5	1.3	5.9	6.4
Total Research	5.9	8.0	1.9	8.6	9.4
Development[3]	10.7	13.2	3.5	15.1	17.0
Total conduct of R&D	$16.6	$21.2	$5.4	$23.7	$26.4
Constant 1972 dollars:					
Basic Research	$ 2.0	$ 1.9	$ .5	$ 1.9	$ 2.0
Applied Research	3.9	4.2	1.0	4.2	4.3
Total Research	5.9	6.1	1.5	6.1	6.3
Development	10.2	10.0	2.6	10.7	11.4
Total conduct of R&D	$16.6	$16.1	$4.1	$16.8	$17.7

Source: "OMB Data for Special Analysis P," and Federal Funds, Volume XXV, NSF.

Note: Detail may not add to total due to rounding.

[1]Budget Authority figures are not available for FY 1972. Data shown are authors' estimates based on obligation data.

[2]The FY 1972 totals are based on the revised estimates for NASA. See text.

[3]These amounts differ from "OMB Data for Special Analysis P" because of updated figures for Defense, which have been estimated from corrected obligation data.

Table 3

R&D Funding for Selected Functions (in millions)

	FY 1975 Actual	FY 1976 Actual	FY 1977 Est.	FY 1978 Budget
Health Research (outlays)[1]				
Total (ex-facilities), current dollars	$2,459	$3,095	$3,301	$3,592
Same, constant 1972 dollars	(1,971)	(2,348)	(2,343)	(2,405)
Environmental R&D Activities (outlays)[2]				
Pollution Control and Abatement	$ 570	$ 724	$ 778	$ 800
Understanding, Describing, and Predicting	592	867	933	1,010
Total, current dollars	$1,162	$1,591	$1,711	$1,810
Same, constant 1972 dollars	(931)	(1,207)	(1,214)	(1,212)
Energy R&D Activities (outlays)[3]				
Non-nuclear R&D	$ 276	-	$ 906	$1,072
Nuclear R&D	856	-	1,508	1,970
Total Direct Energy R&D	$1,132	-	$2,414	$3,042
Supporting Energy R&D	405		513	613
Total, current dollars	$1,537	$2,165 Est.[3]	$2,927	$3,655
Same, constant 1972 dollars	(1,232)	(1,643)	(2,077)	(2,447)
Education, Research (outlays)[4]				
Total, current dollars	$ 416	$ 326	$ 462	$ 580
Same, constant 1972 dollars	(333)	(247)	(328)	(388)
Major Earthquake Hazard Reduction Programs (outlays)[5]				
Geological Survey			$ 11	$ 28
NSF			12	26
Total, current dollars			$ 23	$ 54
Same, constant 1972 dollars			(16)	(36)

[1] "Special Analysis K," FY 1977 and FY 1978 Budgets and AAAS-77.

[2] "Special Analysis Q," FY 1977 and FY 1978 Budgets and AAAS-77.

[3] Issues '78, FY 1978 Budget and AAAS-77. Actual data for FY 1976 are not included in the table in Issues '78. The estimated total from AAAS-77 is shown.

[4] "Special Analysis I,", FY 1977 and FY 1978 Budgets. For a more thorough analysis of education R&D, see R&D System Studies, Technical Reports no. 1 and no. 2, National Institute of Education, 1977.

[5] Issues '78, FY 1978 Budget.

Table 4

Federal R&D, Total Budget, and GNP (in billions)*

	FY 1972 Actual	FY 1975 Actual	FY 1976 Actual	FY 1977 Est.	FY 1978 Budget
Total Federal R&D Outlays	$16.7	$19.6	$21.1	$23.6	$26.6 (26.4)
Total Federal Budget Outlays	$232.0	$326.1	$366.5	$411.2 (417.4)	$440.0 (459.4)
R&D as Percent of Total Budget	7.2%	6.0%	5.8%	5.7% (5.7%)	6.0% (5.7%)
Gross National Product	$1,110.5	$1,450.6	$1,609.5	$1,827.6 (1,830.2)	$2,038.4 (2,047.8)
R&D as Percent of GNP	1.5%	1.4%	1.3%	1.3% (1.3%)	1.3% (1.3%)

Source: The Budget, Ford Budget and Carter Revisions; "OMB Data for Special Analysis P," Ford Budget and Revised; Federal Funds, Volume XXV, NSF.
*Carter revisions shown in parentheses.

Table 5

Estimated Total National Pattern of R&D Funding -- FY 1976

(in billions)

Performers of R&D	Sources of Funds: Federal Government	Industry	Universities & Colleges	Other Nonprofit	All Sources
Federal Government	$ 5.9	---	---	---	$ 5.9
Industry	10.8	$16.3	---	---	27.1
Universities & Colleges	2.6	.1	$ .8	$ .3	3.8
Federal R&D Centers Administered by Universities	1.1	---	---	---	1.1
Other Nonprofit Institutions and All Others	1.3	.1	---	.3	1.7
Total, by source of funds	$21.7	$16.5	$ .8	$ .6	$39.6

Source: National Patterns of R&D Resources, 1953-1976, NSF.

SUMMARY OF DISCUSSIONS

The presentations were followed by questions from the floor, and on the next day by a discussion session which again was chaired by Robert M. O'Neil. Discussion moved freely across the field of research support and higher education. The selective summary below concentrates on issues referring to the official presentations or on issues raised more than once.

Job prospects for new Ph.D.s and persons of equivalent training are bleak in West Germany as they are in the United States. Heinrich Pfeiffer provided details concerning the recent proposal for retaining promising talent for possible later academic employment. Under this plan a private German foundation is to be established with federal funds, and this foundation is to hire between three hundred and six hundred recent doctoral graduates for work at universities, in public research institutes, and even on research projects in industry. This would lessen the threat of emigration by high research potential and might also reduce tendencies toward political unrest. Under a separate program the foundation would give six-year contracts to young university instructors who have completed a postdoctoral degree (Habilitation), give them the title of Heisenberg Professor, and place them at universities alongside the regular professoriate. The National Science Foundation, the Max Planck Society, and the German Research Council, all of which support the plan, assume that within these six years the most promising of the Heisenberg appointees would find regular academic positions.

Konrad von Moltke raised several questions concerning possible drawbacks of the West German support system. He spoke of an essentially "closed" system where awards and uses of funds are controlled by the very group receiving them, namely, the scholarly community. Even educational reform, a major and persistent national issue, can be said to rest in the hands of those who now profit from the modified traditional system. Von Moltke compared this to the American practice of pervasive social and political influence on education and research. The acknowledged and much-admired high level of financial support for research in West Germany can itself be seen as a cause for concern. For example, a strong financial position has enabled research-oriented institutions to ignore the challenge of mass education and to maintain instead a mode of quiet scholarly life which could be called a luxury in the face of national educational needs. Because funds for laboratories and equipment are abundant, these institutions also have not felt the need to cooperate with one another. Pfeiffer responded to the last point by stressing the benefits of research competition among similarly equipped institutes.

Pfeiffer himself had deplored the scholarly jargon which restricts communication

beyond the research community (see page 11). In connection with this, George Romoser described projects funded by NEH where scholars go into the communities to faciliate a general discussion of value issued and an exchange of views through a common linguistic medium. "It is not as much a matter of developing values as of seeing what people's values are and of helping them understand what those values may imply for the future." Pfeiffer in turn pointed to the Max Planck Institute in Starnberg which is concerned with "Research in Living Conditions in the Scientific-Technological World." At this institute values or models of value systems are being developed for our time and for the future. Thus a difference between the American and the German approach became apparent in that the former is intended to elicit discussions within the citizenry and guidance for the scholar whereas the latter expects scholars to chart values for the whole society.

Moves in the direction of the American model were attempted in Germany after World War II: representatives from industry, trade unions, and other non-scholarly groups were to sit on governing boards of German universities. The universities rejected this; they feared an intrusion on their freedom of teaching and research, and their opinion prevailed. Today however the outside groups are courted as potential sponsors of research; they also conduct retreats and conferences for their employees for which they enlist the help of scholars.

John Woodcock described some of the community projects currently sponsored by the Indiana Committee for the Humanities: weekend courses on the future and on the uses of science fiction for town planners and citizens, creative writing courses in penitentiaries, or discussions of scientific problems and public policy issues as they relate to farming communities. In West Germany, the adult education system and public radio and television pay attention to similar concerns.

Several times discussions returned to comparisons between work in the sciences and work in the humanities (including social sciences). Toufiq Siddiqi questioned the notion that science gives us better ways of doing things, not better things to do. Many scientists might not agree. The statement should be more narrowly applied to technology; the sciences, the humanities, and the arts may indeed be giving us better things to do. Woodcock in turn drew a distinction between scientists and humanists by the type of problems they like to address. "Scientists like to work with solvable problems; humanists on the other hand are in the position of the novelist, who knows that every novel must finally be abandoned before it is completely solved. Politicians deal with problems which must finally be abandoned too. One cannot arrange the variables to make the issue look like a scientific problem. Social problems contain many uncontrollable and even unknowable elements. The combination of the complexity and the need to decide before all the information is

in, <u>well</u> before sometimes, makes politics resemble the humanities." And, one might add, the arts.

It was agreed that scientists can serve as effective spokesmen for the humanities, especially when they can refer to the indirect influence of humanistic training on their own careers and successes. It has also become quite apparent that many scientists no longer see themselves as working in an essentially value-free field. At scientific conventions in the United States, up to one-third of the sessions now deal with value-related topics. This again underscores the need for communication and connection with society at large.